



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/019,521	06/06/2002	Peter J. Schuller	110.01100101	2112
26813	7590	10/30/2003	EXAMINER	
MUETING, RAASCH & GEBHARDT, P.A. P.O. BOX 581415 MINNEAPOLIS, MN 55458			STUI.TZ, JESSICA T	
			ART UNIT	PAPER NUMBER
			2873	

DATE MAILED: 10/30/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/019,521

Applicant(s)

SCHILLER, PETER J.

Examiner

Jessica T Stultz

Art Unit

2873

-- The MAILING DATE of this communication appears on the cover sheet with correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-27 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-9, 11-20 and 23-27 is/are rejected.
- 7) ☒ Claim(s) 10, 21-22 is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 10/11/2002 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on ____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). ____
- 2) ☐ Notice of Draftperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) ____ 6) ☐ Other: ____

DETAILED ACTION

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-3, 5-6, 8-9, 11, 15-16, 18-20, 23, and 26-27 are rejected under 35 U.S.C. 102(b) as being anticipated by Mastrangelo.

Regarding claim 1, Mastrangelo discloses a method of manufacturing a micro-electromechanical device having front and back sides (Shown in Figures 4A-O), the method comprising: providing a substrate comprising a first side located proximate the front side of the device and second side proximate the back side of the device (Column 6, lines 3-18, wherein the substrate is silicon wafer “10”, Figures 4A-O); providing a sacrificial material on a selected area of the first side of the substrate (Column 6, lines 3-18, wherein the sacrificial material is the etch-stop area “20”, Figure 4A); providing a diaphragm layer on the sacrificial material and the first side of the substrate surrounding the sacrificial material in the selected area (Column 6, lines 19-23, wherein the diaphragm layer is silicon layer “30”, Figure 4B); providing at least one transducer on the front side of the device (Column 6, lines 19-Column 8, line 9, wherein the transducers comprise bottom electrodes “40” and top electrodes “60”, Figures 4D-O), the transducers located over the sacrificial material (Shown in Figures 4D-O), wherein the transducers comprise transducing material and electrical contacts in electrical communication with the transducing material (Column 6, line 19-Column 8, line 9, wherein the electrical

contacts are electrode holes "80a-80c" and LTO layers "50" and "66", which contact both electrodes "40" and "60", Figures 4E-K), forming a void in the substrate from the second side of the substrate towards the first side of the substrate after providing the transducer on the front side of the device (Column 7, lines 11-28, wherein the void is formed by a silicon etch solution, Figure 4H); wherein at least a portion of the sacrificial material is exposed within the void proximate the first side of the substrate (Shown in Figure 4H, wherein the etch stops at the etch stop "20"); and removing at least a portion of the sacrificial material through the void, wherein a portion of the diaphragm layer is suspended directly above the substrate within the selected area (Column 7, lines 11-28, wherein the layer "20" is removed and the diaphragm layer "30" is suspended, Figure 4I).

Regarding claim 3, Mastrangelo further discloses a method of manufacturing a micro-electromechanical device as disclosed above wherein the void is formed by etching the substrate while the electrical contacts are exposed on the front side of the device (Column 6, line 63-Column 7, line 28, wherein the void is formed by a silicon etch solution, wherein the electrical contact LTO layer "66", which connects upper electrode "60" and the lower electrode "40", is exposed Figures 4G-H).

Regarding claim 5, Mastrangelo further disclose that removing the sacrificial material comprises selectively etching the sacrificial material (Column 7, lines 11-28, wherein the void is formed by a silicon etch solution, Figures 4H-I).

Regarding claim 6, Mastrangelo further discloses that removing the sacrificial material comprises selectively etching the sacrificial material by exposing only the backside of the device to an etchant (Column 7, lines 11-28, Figures 4H-I).

Regarding claim 11, Mastrangelo further discloses a method of manufacturing as disclosed above wherein the void comprises an opening within the selected area on the first side of the substrate that is smaller than the selected area occupied by the sacrificial area (Shown in Figures 1 and 4I-O).

Regarding claim 15, Mastrangelo discloses a substrate assembly having front and back sides (Shown in Figures 4A-O), the assembly comprising: a substrate comprising a first side located proximate the front side of the device and second side proximate the back side of the substrate assembly (Column 6, lines 3-18, wherein the substrate is silicon wafer "10", Figures 4A-O); sacrificial material on the first side of the substrate in a plurality of selected areas (Column 6, lines 3-18, wherein the sacrificial material is the etch-stop area "20", Figure 4A); a diaphragm layer covering the sacrificial material in the selected areas (Column 6, lines 19-23, wherein the diaphragm layer is silicon layer "30", Figure 4B), the diaphragm layer extending to cover the first side of the substrate surrounding the sacrificial material in the selected areas (Shown in Figure 4B); a plurality of transducers on the front side of the device, each of the transducers located over at least a portion of each of the selected areas (Column 6, lines 19-Column 8, line 9, wherein the transducers comprises the bottom electrodes "40" and the top electrodes "60", Figures 4D-O), wherein the transducer comprises transducing material and electrical contacts in electrical communication with the transducing material (Column 6, line 19-Column 8, line 9, wherein the electrical contacts are electrode holes "80a-80c" and LTO layers "50" and "66", which contact both electrodes "40" and "60", Figures 4E-K), wherein the sacrificial material in the selected areas is encapsulated between the substrate and the diaphragm layer (Shown in Figures 4B-4G).

Regarding claims 2 and 16, Mastrangelo further discloses a method of manufacturing a micro-electromechanical device and a device as disclosed above wherein the suspended portion of the diaphragm layer and the substrate form an included angle at their junction of less than 90 degrees (Shown in Figures 1 and 4I-O).

Regarding claim 18, Mastrangelo further discloses that the micro-electromechanical device as disclosed above include the sacrificial material being selectively removable with respect to the diaphragm layer and the substrate (Column 7, lines 11-28, wherein the layer "20" is removed, Figure 4I).

Regarding claim 23, Mastrangelo discloses a micro-electromechanical device having front and back sides (Shown in Figures 4A-O), the device comprising; a substrate comprising a first side located proximate the front side of the device and second side proximate the back side of the device (Column 6, lines 3-18, wherein the substrate is silicon wafer "10", Figures 4A-O); a void formed through the first and second sides of the substrate (Column 7, lines 11-28, wherein the void is formed by a silicon etch solution, Figure 4H), the void formed comprising an opening proximate the first side of the substrate (Shown in Figure 4H); and a diaphragm layer spanning the opening proximate the first side of the substrate (Column 6, lines 19-23, wherein the diaphragm layer is silicon layer "30", Figure 4B); and a diaphragm layer spanning the opening in the first side of the substrate and attached to the first side of the substrate (Shown in Figures 1 and 4I-O), wherein a portion of the diaphragm layer and the substrate form an included angle at their junction of less than 90 degrees (Shown in Figures 1 and 4I-O).

Regarding claim 26, Mastrangelo discloses a micro-electromechanical device as disclosed above comprising a transducer on the diaphragm layer, (Column 6, lines 19-Column 8,

line 9, wherein the transducers comprises the bottom electrodes "40" and the top electrodes "60", Figures 4D-O) wherein the transducer is located above at least a portion of the suspended portion of the diaphragm layer (Figures 4D-O).

Regarding claims 8-9, 19-20, and 27, Mastrangelo further discloses a method of manufacturing and a device as disclosed above wherein providing the sacrificial material comprises depositing a layer of the sacrificial material on the first side of a planar substrate in the selected area (Figure 4A).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 4, 7, 12-14, 17, and 24-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mastrangelo in view of Ishida et al.

Regarding claims 4 and 17, Mastrangelo discloses the method of manufacturing a device and a device as disclosed above with electrical contacts wherein the void is formed by etching through the substrate while the contacts are exposed on the front side of the device (Column 6, line 63-Column 7, line 28, wherein the void is formed by a silicon etch solution, wherein the electrical contact LTO layer "66", which connects upper electrode "60" and the lower electrode "40", is exposed Figures 4G-H), but does not specifically disclose that the contacts are metallic. Ishida et al teaches of a mems device (accelerometer sensor "1") wherein a void is made (Figure 12) and a sacrificial layer is removed (Figure 13) specifically wherein electrical contacts are

metallic (Column 3, lines 46-55, wherein the wiring contacts "12" are aluminum, which connect to bonding pads "13", Figure 2a) for the purpose of connecting the sensor to external devices or circuits (Column 3, lines 56-67). Therefore it would have been obvious to one having ordinary skill in the art at the time the invention was made for the method of manufacturing a device and the device of Mastrangelo further include the use of metallic electrical contacts since Ishida et al teaches of a mems device wherein a void is made and a sacrificial layer is removed specifically wherein electrical contacts are metallic for the purpose of connecting the sensor to external devices or circuits.

Regarding claim 7, Mastrangelo discloses the method of manufacturing a device as disclosed above but does not specifically disclose that the etchant is in a gas phase. Ishida et al teaches of a mems device (accelerometer sensor "41") wherein a void is made (Figure 17) and a sacrificial layer is removed (Figure 17) specifically wherein the etchant in a gas phase (Column 9, lines 45-50 and Column 10, lines 48-53) for the purpose of performing reaction ion etching rather than non-reactive etching (Column 10, lines 48-53). Therefore it would have been obvious to one having ordinary skill in the art at the time the invention was made for the method of manufacturing of Mastrangelo further include the use of metallic electrical contacts since Ishida et al teaches of a mems device wherein a void is made and a sacrificial layer is removed specifically wherein the etchant in a gas phase for the purpose of performing reaction ion etching rather than non-reactive etching.

Regarding claims 12-13 and 24, Mastrangelo discloses the method of manufacturing a device as disclosed above but does not specifically disclose that the void in the substrate comprises a proof mass attached to the diaphragm layer, the proof mass comprising a portion of

the substrate that is separated therefrom, wherein the void is in the shape of an annular ring and the proof mass is cylindrical. Ishida et al teaches of a mems device (accelerometer sensor "36") wherein a void is made (Figure 16) and a sacrificial layer is removed (Figure 16) specifically comprises a proof mass attached to the diaphragm layer (Column 9, lines 51-50, wherein the proof mass is the portion "37"), the proof mass comprising a portion of the substrate that is separated therefrom (Shown in Figure 16), wherein the void is in the shape of an annular ring and the proof mass is cylindrical (Column 9, lines 51-60, wherein the void is an annular ring and the proof mass "37a" is cylindrical, Figure 16) for the purpose of providing improved sensitivity of the accelerometer sensor due to the increased mass of the proof mass (Column 9, lines 61-67). Therefore it would have been obvious to one having ordinary skill in the art at the time the invention was made for the for the method of manufacturing of Mastrangelo further include the void in the substrate comprising a proof mass attached to the diaphragm layer, the proof mass comprising a portion of the substrate that is separated therefor, wherein the void is in the shape of an annular ring and the proof mass is cylindrical since Ishida et al teaches of a mems device wherein a void is made and a sacrificial layer is removed specifically comprising a proof mass attached to the diaphragm layer, the proof mass comprising a portion of the substrate that is separated therefrom wherein the void is in the shape of an annular ring and the proof mass is cylindrical for the purpose of providing improved sensitivity of the accelerometer sensor due to the increased mass of the proof mass.

Regarding claims 14 and 25, Mastrangelo further discloses a method of manufacturing a micro-electromechanical device and device as disclosed above wherein the suspended portion of

the diaphragm layer and the substrate form an included angle at their junction of less than 90 degrees (Shown in Figures 1 and 4I-O).

Allowable Subject Matter

Claims 10 and 21-22 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is an examiner's statement of reasons for allowance: none of the prior art alone or in combination disclose or teach of the claimed combination of limitations to warrant a rejection under 35 USC 102 or 103.

Specifically regarding claims 10 and 21-22, none of the prior art alone or in combination disclose or teach of a method of manufacturing a device or a device as disclosed above specifically wherein the sacrificial material is reflowable, and wherein the method further comprises reflowing the sacrificial material.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jessica T Stultz whose telephone number is (703) 305-6106. The examiner can normally be reached on M-F 8-4:30.

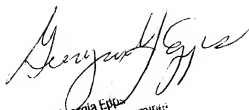
If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Georgia Epps can be reached on 703-308-4883. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

Art Unit: 2873

A handwritten signature in black ink, appearing to read "Jessica Stultz".

Jessica Stultz

A handwritten signature in black ink, appearing to read "Georgia Epps".

Georgia Epps
Supervisory Patent Examiner
Technology Center 2800